This document includes Section 1.0, Introduction and Table of Contents, of the Draft EPA Report "Surface Vessel Bilgewater/Oil Water Separator Feasibility Impact Analysis Report" published in 2003. The reference number is: EPA-842-D-06-019

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Feasibility Impact Analysis Report Surface Vessel Bilgewater/Oil Water Separator

Section 1.0 – Introduction and Table of Contents

2003

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FEASIBILITY IMPACT ANALYSIS REPORT

SURFACE VESSEL BILGEWATER/
OIL WATER SEPARATOR (OWS)

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SECTION 1.0 – INTRODUCTION

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1.0 INTRODUCTION

The Feasibility Impact Analysis Report (FIAR) examines three of the seven considerations specified in the Uniform National Discharge Standards (UNDS) legislation for establishing performance standards for marine pollution control devices (MPCDs):

- Practicability of using the MPCD;
- Effect that installation or use of the MPCD would have on the operation or operational capability of the vessel; and
- Economic costs of the installation and use of the MPCD.

The analysis is organized by vessel group and analyzes feasibility criteria for each MPCD option group relative to each representative vessel. The feasibility criteria were considered for both existing vessels and new design vessels. Feasibility analyses were performed for each MPCD option group that passed the MPCD screening process. MPCD option groups may be management practices, alternative materials, or control devices. The specific criteria considered in the feasibility analyses are detailed in the Feasibility Analysis Guidance Document for Phase II of the Uniform National Discharge Standards for Vessels of the Armed Forces (Navy and EPA, 2000a). Information used in this report is distinguished by belonging to either of two general categories: 1) general collected data that are subject to uncertainty analysis and the rules of significant figures (see Appendix A for significant figure rules), and 2) assumptions that are based on best available expertise and are treated as constants for calculation purposes. The Navy's Alteration and Installation Team (AIT) and Total Ship System Directorate of the Naval Surface Warfare Center, Carderock Division (NSWCCD Code 20) supported the development of these analyses. Their estimates and conclusions are referenced throughout this report.

Within each Personnel Impact section, the maintenance activities for each MPCD are presented as time-based maintenance and condition-based maintenance. Time-based maintenance includes maintenance activities performed according to a preset calendar schedule and is independent of the number of hours the MPCD is operated. Condition-based maintenance includes all maintenance activities that are dependent upon the number of hours the MPCD is operated. Hours of MPCD operation were estimated based on the amount of time it takes to process the volume of bilgewater generated annually.

Annualized maintenance hours for both time-based maintenance and condition-based maintenance were estimated by multiplying the maintenance time by the frequency. The maintenance time is the amount of time required to complete the maintenance activity. The frequency indicates how often the maintenance activity will be performed. For time-based maintenance, the frequency is a function of time (e.g., annual, semi-annual, quarterly). For condition-based maintenance, the frequency is a function of MPCD operating hours (e.g., every 500 hours). The annualized maintenance hours are the total number of hours required for a maintenance activity over a one-year period. Dependent upon the nature of the MPCD's operating parameters and the vendor maintenance recommendations, the FIAR provides a table for both condition-based maintenance and time-based maintenance. The condition-based maintenance table presents both the annualized maintenance hours performed inside and beyond

12 nautical miles (nm). The time-based maintenance table only shows annualized maintenance because time-based maintenance is performed according to a schedule and is independent of where and how often the MPCD is operated.

1.1 ECONOMIC COST ANALYSIS

The cost analyses are for comparative purposes only and are not intended for preparation of budgets or determination of actual costs. To the extent possible, the analyses divide cost estimates between vessel operations within 12 nm of shore and vessel operations beyond 12 nm.

Economic costs were estimated using Automated Cost Estimating Integrated Tool (ACEIT) software. The ACEIT software is widely used within the DoD cost analysis community (ACEIT, 1999). All costs are presented in 1999 dollars. Summary tables that present how costs were converted to 1999 dollars are shown in Appendix A. Cost data for individual initial and recurring cost items that were obtained subsequent to fiscal year 1999 were converted to 1999 dollars using the Consumer Price Index (CPI). The CPI is a general inflation rate published by the Bureau of Labor Statistics. More specialized inflation rates exist for specific costs (e.g., labor rates, machinery procurement cost, oily wastewater disposal cost); however, because costs were adjusted over a very short time period, using specialized inflation rates would not significantly affect the outcome of the calculations.

1.1.1 Initial Cost

The initial cost estimate for each MPCD option group may include acquisition, installation, and technical data development costs. The estimated initial costs are the incremental costs, or additional costs, to install the MPCD. If the MPCD is already installed, there are no incremental costs. Acquisition cost reflects the required number of appropriately sized models of a particular MPCD to achieve the required processing rate per vessel, for the representative vessel class. Acquisition costs were provided by vendors, representative MPCD model manufacturers, or equipment experts with acquisition cost knowledge. Acquisition costs may vary between manufacturers; however, that difference is not expected to be significant. The development of installation cost estimates and technical data development cost estimates required the use of assumptions based upon Navy experience.

Installation costs include the cost of labor, materials, and oversight to install the MPCD system on one vessel within the representative vessel class, including any required structural modifications, equipment relocations, etc. Installation costs were estimated by the AIT unless referenced otherwise in the subsequent cost analyses (e.g., new design analyses).

Technical data development costs include costs associated with the development of technical manuals, technical drawings, and training materials necessary for installation, operation, and maintenance of the MPCD system for a vessel group. Technical manuals contain instructions for proper installation, operation, and maintenance of the equipment. Technical drawing costs for installation were estimated by the Navy AIT and considered by NSWCCD Code 20 for the new design analyses. The cost of training materials includes the cost to develop and implement a new module into an existing training course. Training module development costs were assumed to be

consistent across applicable MPCD option groups and were based on past Navy experience. Whereas all other cost elements of the total ownership cost (TOC) represent the costs to an individual vessel within the representative vessel class, technical data development costs are fixed costs incurred by the vessel class. Therefore, the FIAR includes this one-time fixed cost that will be incurred by the vessel class. However, this cost was pro-rated, based on the number of vessels in the representative vessel class, to calculate the initial cost for the representative vessel. The individual initial cost items are described under the Initial Cost sections and totaled under the Total Ownership Cost sections.

1.1.2 Recurring Cost

The recurring costs considered in the subsequent analyses may include labor for operating and maintenance, consumable cost, and waste material disposal costs. These costs and associated assumptions and calculations are reported under the respective Personnel Impact sections. The recurring costs are incurred on an annual basis. The individual recurring cost items are described under the Recurring Cost sections and totaled under the Total Ownership Cost sections. The annual labor cost was estimated by adding the personnel labor requirement for operating equipment and transferring waste oil to shore to the routine maintenance labor requirement.

The costs are reported in hours per year and multiplied by an hourly labor rate of $22.64. The $22.64 hourly labor rate is the E-5 military pay grade as reported in the FY 1999 Annual DoD Composite Rate prepared by the Office of the Under Secretary of Defense Comptroller. The E-5 grade was selected based on the assumption that a sailor of E-5 grade will perform the majority of MPCD operation and maintenance. Because the labor rate is an assumption, it is treated as a constant for calculation purposes. Many sailors below grade E-5 may not be qualified to operate or maintain MPCD systems, and most sailors above grade E-5 perform supervisory roles. The E-5 labor rate assumption is consistent with previous cost estimates performed by the Navy (Verosto, 2000). This labor rate is not reflective of the labor rate associated with the installation of equipment, which is typically higher. Labor costs associated with equipment installation were included in the initial costs of installation, as discussed under Initial Cost, above.

Although most recurring costs account for costs incurred during vessel operation within 12 nm and while in port, the MPCD maintenance costs reflect maintenance that occurs throughout the year. The MPCD maintenance cost within 12 nm includes the time-based maintenance cost and the condition-based maintenance cost that results from operating the MPCD within 12 nm. The MPCD maintenance cost beyond 12 nm only includes the condition-based maintenance that results from operating the MPCD beyond 12 nm. If the cost of consumables was significant, it was annualized and estimated as a recurring cost.

The recurring cost associated with disposal of waste material was calculated by multiplying the annual volume of waste material generated by the waste material disposal unit cost. There is uncertainty associated with waste material disposal costs because of the variability of economic factors associated with those costs (e.g., the availability of contractors willing to transport and dispose of waste materials). However, that uncertainty is not expected to affect the outcome of the analysis because changes in economic factors will be associated with local areas or regions and should not significantly affect the average price used for the analysis. Typically, the unit

cost of waste material disposal differs by material. Whereas untreated bilgewater is disposed of as oily wastewater, the concentrated oil effluent removed from the bilgewater by an oil water separator (OWS) must be disposed of as waste oil. The oily wastewater disposal cost is $.0749 per gallon, which is an average of oily waste disposal unit costs for individual ports along the Atlantic coast, Gulf of Mexico, Pacific northwest and Pacific southwest ports, weighted by the number of ship visits per port in fiscal years 1995 and 1998 (Navy, 1998). It should be noted that this average cost is most representative of costs incurred by the Navy. The U.S. Coast Guard (USCG) incurs a significantly higher per gallon disposal cost. The oily waste disposal cost for USCG vessels operating on the Great Lakes is $1.25 per gallon. The average oily waste disposal cost for all other USCG vessels is $0.80 per gallon (Volpe, 2000a). The recurring cost associated with the disposal of oily wastewater on USCG vessels was calculated using a disposal cost of $0.91 per gallon, which is the weighted average of oily waste disposal costs for USCG vessels on the Great Lakes and the oily waste disposal cost of all other USCG vessels.

The bilgewater generated annually within 12 nm multiplied by the oily waste disposal unit cost produced the recurring disposal cost for the collection, holding, and transfer (CHT) MPCD option. A recent Navy waste disposal cost study indicates that most U.S. ports where transfer facilities are available accepted waste oil from Naval vessels at no cost (Navy, 1998). The contractor accepting the oil sells or recycles the waste oil. The Coast Guard pays private contractors to offload waste oil from Coast Guard vessels. The Coast Guard pays the same average disposal cost of $0.91 per gallon for waste oil as for oily wastewater (Volpe, 2000a). Because of the significant difference between Navy and Coast Guard oily wastewater and waste oil disposal costs, the recurring cost was calculated separately using Navy and Coast Guard disposal costs. The recurring costs are presented for both within and beyond 12 nm. Other Armed Forces vessels are assumed to incur costs similar to the representative vessels.

1.1.3 Total Ownership Cost (TOC)

The TOC is a sum of the total initial and the total recurring costs. The ACEIT model estimated the TOC of each MPCD option group over a 15-year lifecycle. This model assumes that acquisition and installation occur during year one of the 15-year lifecycle, and MPCD operation begins the following year. Therefore, the first year reflects initial costs only, and years two through 15 reflect recurring costs only. The ACEIT model presents the cost-estimate results as total initial, total recurring, and overall total cost expressed in 1999 dollars. ACEIT discounted future costs (i.e., recurring cost) using discounted cash flow methodology to account for the time value of money. The cost analysis used a discount rate of 3.2% that was based on the real interest rates on 15-year Treasury Notes and Bonds (OMB, 1992). The figures are for comparing MPCD options only and are not intended for preparation of budgets.

1.1.4 Annualized Cost

Annualized costs were calculated using standard annualization methods. Annualized costs are presented for comparing costs of MPCD option groups. Annualized costs also were used in subsequent cost effectiveness analyses in the Discharge Assessment Report.

1.2 NEW DESIGN VESSELS

Vessels in the design stage ("new design vessels") are vessels authorized by Congress and for which the Department of Defense or the Coast Guard has developed a program office to oversee their design. Assessments reported in the FIAR were developed using the assumption that new design vessels will have similar discharge characteristics (e.g., bilgewater constituent composition) as a representative existing vessel and will have reasonable flexibility in general design specifications.

New design analyses parallel existing representative vessel classes and follow new design analysis guidelines (UNDS, 2002). A new design vessel's ability to collect bilgewater may also be improved by designing systems that reduce the amount of bilgewater generated. As discussed in Shipboard Compliance and Pollution Prevention Program (Navy and EPA, 2002), the Navy is implementing several pollution prevention initiatives to reduce bilgewater generation volumes. These include incorporating non-oily machinery wastewater collection systems, or "dry bilge," into the ship design, installing mechanical seals on pumps, and developing improved shaft seals.

MPCD feasibility for new design vessels was analyzed using existing vessels as a baseline, as described below:

- At a minimum, new design vessels were assumed to be able to accommodate MPCDs that are in–place or were determined to be viable for installation on corresponding existing vessels. Therefore, these "in-place" MPCDs were not analyzed for new design vessels because they were expected to have the same impacts on existing vessels.
- Only MPCDs providing an additional environmental benefit over the in-place MPCDs were analyzed.
- Professional judgment was used to compare the feasibility (i.e., practicability, economic costs, and operational impacts) of installing and using an MPCD on a new design vessel to that of an in-place MPCD. Installation cost for an MPCD aboard a new design vessel was assumed to be 67% of the cost for retrofitting the device aboard an existing vessel (UNDS, 2002).

1.3 ADDITIONAL ASSUMPTIONS

In addition to the cost estimation assumptions explained above, the following assumptions were made to facilitate the feasibility impact analysis. For calculation purposes, analysis parameters that do not vary across MPCD options were treated as constants.

- The cost of maintenance, repair parts, consumables, general operation, and operations associated with wastewater transfer pumps were not considered in this analysis. Wastewater transfer pumps are an integral component of the oily waste management system on Armed Forces vessels. These pumps move the wastewater from one location to another (e.g., from the bilge to a holding tank, or from a holding tank to the MPCD). However, the general use and operation of these pumps are not expected to vary greatly among the potential bilgewater MPCDs within a vessel group. These pumps operate in

accordance with the bilgewater generated, not in response to the potential control device. Therefore, the costs associated with wastewater transfer pumps are independent of the selected MPCD. Pumps used by an MPCD option as part of its treatment process (e.g., membrane recirculation pumps, feed pumps) were considered in the feasibility analysis.

- Equipment start-up and shut down times were assumed to be the same for all MPCDs, and therefore were excluded from labor and cost estimates.

- Analysis includes estimated costs resulting from MPCD operation beyond 12 nm. These costs were estimated based on vessel and MPCD operating times beyond 12 nm. Vessel operating time beyond 12 nm was assumed to be the number of days remaining in the calendar year that the vessel is not underway within 12 nm or in port. For example, according to Department of Defense data, CVN 68 Class vessels spend approximately 150 days in port or operating within 12 nm each calendar year. Therefore, it is assumed that CVN 68 Class vessels spend 215 days (i.e., 365 days minus 150 days) beyond 12 nm. At this time, the Armed Forces are not anticipating running secondary OWS systems beyond 12 nm. The existing primary OWS systems are designed to comply with current regulatory requirements beyond 12 nm [e.g., the International Convention for the Prevention of Pollution from Ships (MARPOL)]. Therefore, MPCD operational impacts beyond 12 nm are based upon secondary treatment being bypassed.

- Other than Coast Guard vessels, oily waste water disposal costs incurred by military vessels were assumed to be the same as the waste oil and oily wastewater disposal cost incurred by the Navy.

- Bilgewater generation rates were treated as constants in feasibility analysis calculations. Because the generation rate is the same for each MPCD within a vessel group, the uncertainty associated with the bilgewater generation rate does not affect the analysis.

- Vessel operating profile values (i.e., the number of days a vessel is pierside, is operating within 12nm, and is operating beyond 12 nm) were treated as constants for calculation purposes. Because the vessel operating profile is the same relative to each MPCD within a vessel group, the uncertainty associated with the vessel operating profile does not affect the outcome of the analysis.

- This analysis assumes that one percent of the bilgewater processed by both primary and secondary MPCDs is directed to the waste oil tank. The assumption was based upon prior U.S Navy experience with OWS operation (Navy, 1998).

- This analysis assumes that MPCDs will require 0.25 hours of oversight for every two hours of operation. The assumption was based upon Navy experience, which indicates that although MPCDs are automatic, a crewmember will be assigned to supervise the operation of multiple pieces of equipment at any given time.

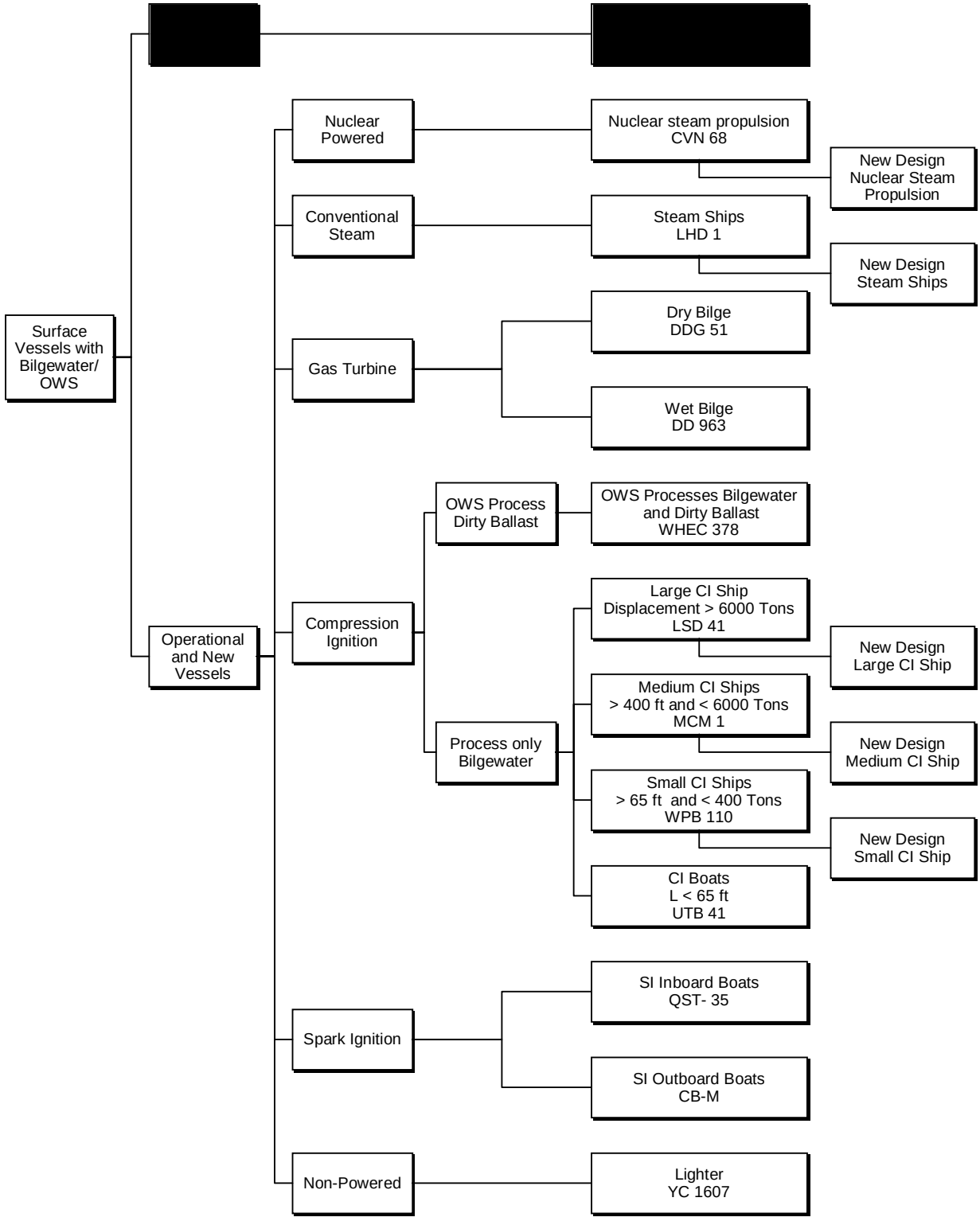
- This analysis assumes that maintenance for time-based and condition-based maintenance will be performed according to the appropriate schedule.

1.4 VESSELS THAT GENERATE SURFACE VESSEL BILGEWATER/OIL WATER SEPARATOR (OWS) DISCHARGE

To facilitate the analyses of potential MPCD option groups, vessels generating surface vessel bilgewater/OWS effluent were divided into groups according to similar vessel operational characteristics and discharge characteristics (e.g., operational status of vessel, type of propulsion plant, and vessel size). The resulting vessel groupings and representative vessels for analysis of surface vessel bilgewater are illustrated in Figure 1-1.

This feasibility impact analysis was conducted in accordance with the characteristics of the representative vessel class from each vessel group. With the exception of waste oil disposal costs, all results are indicative of and applicable to the representative vessel class, as well as to all other vessels within the representative group. The specific vessel classes selected to represent each subgroup are shown in Figure 1-1.

Figure 1-1. Bilgewater Vessel Groupings



1.5 MPCD OPTIONS CONSIDERED

Nine MPCD option groups passed the MPCD screening process and are categorized as either primary control options for the treatment of raw surface vessel bilgewater or secondary control options for the treatment of OWS effluent from a primary OWS system. Table 1-1 lists the primary and secondary MPCD option groups.

Table 1-1. MPCD Option Groups

Primary MPCD Options	Secondary MPCD Options
Gravity coalescence[1]	Filter media
CHT[2]	Membrane Filtration
Centrifuge	
Evaporation	
Hydrocyclone	
In situ biological treatment	
Oil-absorbing socks	

[1] Current MPCD for CVN 68, DDG 51, DD 963, LHD 1, LSD 41, WHEC 378, WLM 175, WPB 110
[2] Current MPCD for UTB 41, CB-M, QST 35, YC 1637

The above MPCDs are described fully within their respective MPCD screen documents.